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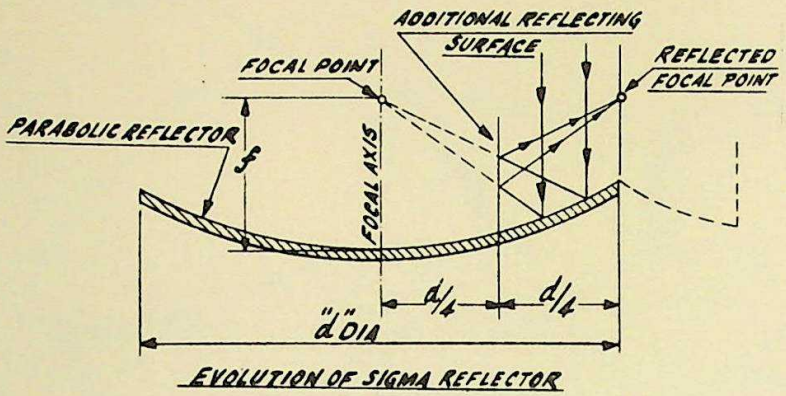
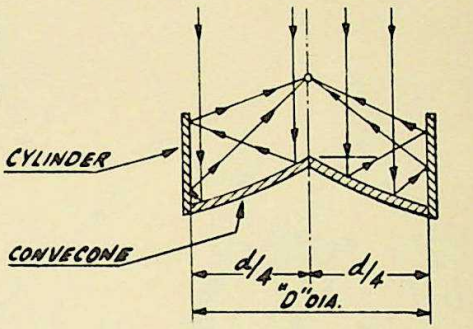
SURFACE DESIGN TECHNIQUES

Neil W. Burwell



EVOLUTION OF SIGMA REFLECTOR
Fig. 1.



BASIC SIGMA REFLECTOR
Fig. 2.

Disclosed is a technique for forming woven contoured surfaces which are saddle shaped or, more specifically, are said to have a negative Gaussian curvature. Though generally applicable to any surface exhibiting such a negative curvature, the disclosed technique has been found to be particularly applicable in the construction of the Sigma Antenna.

The Sigma Antenna was first conceived as a reflector system having variable beam width and high efficiency characteristics. Its basic shape was evolved from a parabolic reflector with an additional vertical surface placed halfway between the focal axis and the edge of the reflector (Figure 1). This additional surface produces a "reflected focal point" which lies on the same line as the original focal point but vertically above the edge of the parabolic reflector. The Sigma is then formed by sweeping this outer section about the vertical line at the edge of the reflector so forming the Greek letter sigma (Σ). (Figure 2).

The surface of the "convecone" portion of the Sigma Antenna (Figure 3) is saddle shaped or said to have a negative Gaussian curvature. Any point P on this surface is defined by two principal curvatures perpendicular to one another with their centers lying on the normal to the

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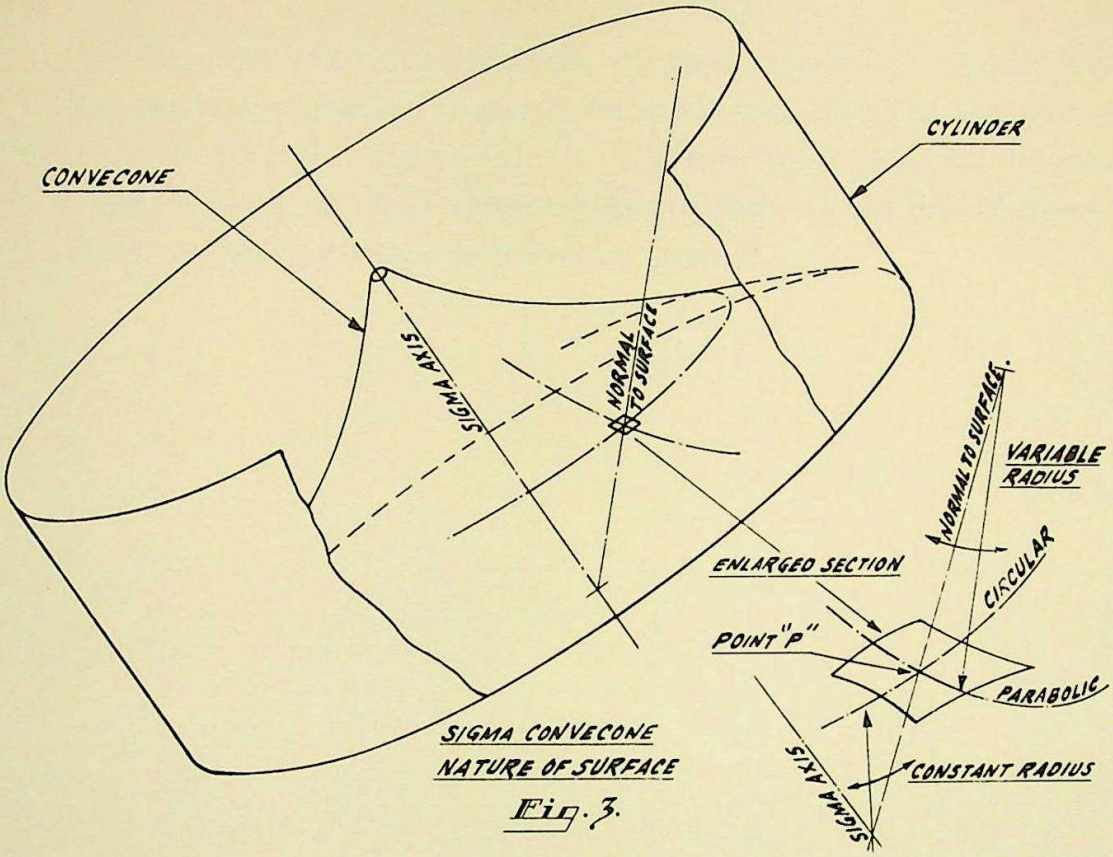

Fig. 3.

surface at P but on opposite sides of the surface. Considering the surface to be of suitably woven non-stretchable "cloth", if point P is depressed towards the sigma axis, tension will increase in the parabolic threads so resisting the motion; if point P is moved out away from the sigma axis, tension will increase in the circular threads, again resisting the motion. The desired surface characteristics may be achieved by properly selecting strands of differing length from which the surface is woven, thereby resulting in a surface having correct tensions between the circular and parabolic threads. Furthermore, it has been found that the structure so formed may be repeatedly folded and deployed with assurance that the mechanical characteristics of the "cloth" will provide a surface exhibiting the desired negative curvature within close tolerances.

While the disclosed technique has been described in association with the Sigma Antenna, it should be understood that its application is not so limited. For example, it has been found that the surface of a pane of glass or other semi-flexible surface can be formed so as to exhibit a negative curve in a similar manner.